GUIDELINES FOR IMPROVING COMMUNICATIONS WITH VISUALLY IMPAIRED USERS OF RAIL RAPID TRANSIT SYSTEMS.

OMB Approval No. 29-R

FEDERAL ASSISTANCE

2. APPLICANT'S APPLICATION	a. NUMBER	3. STATE APPLICATION IDENTIFIER	a. NUMBER
	b. DATE Year month day 19 80 3 1		b. DATE ASSIGNED Year month 19

1. TYPE OF ACTION (Mark appropriate box)
- ☐ PREAPPLICATION
- ☒ APPLICATION
- ☐ NOTIFICATION OF INTENT (Opt.)
- ☐ REPORT OF FEDERAL ACTION

Leave Blank

SECTION I—APPLICANT/RECIPIENT DATA

4. LEGAL APPLICANT/RECIPIENT

a. Applicant Name : Boston College
b. Organization Unit : Division of Special Educ. & Rehab.
c. Street/P.O. Box : 140 Commonwealth Ave.
d. City : Chestnut Hill
e. County : Middlesex
f. State : Mass
g. ZIP Code: 02167
h. Contact Person (Name & telephone No.) : Alec F. Peck (617)969-0100 X4180

5. FEDERAL EMPLOYER IDENTIFICATION NO.

6. PROGRAM (From Federal Catalog)
a. NUMBER
b. TITLE

7. TITLE AND DESCRIPTION OF APPLICANT'S PROJECT

Guidelines for Improving Communications with Visually Impaired Users of Rail Rapid Transit Systems

8. TYPE OF APPLICANT/RECIPIENT
A-State; B-Interstate; C-Substate District; D-County; E-City; F-School District; G-Special Purpose District; H-Community Action Agency; I-Higher Educational Institution; J-Indian Tribe; K-Other (Specify):
Enter appropriate letter

9. TYPE OF ASSISTANCE
A-Basic Grant; B-Supplemental Grant; C-Loan; D-Insurance; E-Other
Enter appropriate letter(s): A

10. AREA OF PROJECT IMPACT (Names of cities, counties, States, etc.)

11. ESTIMATED NUMBER OF PERSONS BENEFITING

12. TYPE OF APPLICATION
A-New; B-Renewal; C-Revision; D-Continuation; E-Augmentation
Enter appropriate letter

13. PROPOSED FUNDING

a. FEDERAL	$ 76,568 .00
b. APPLICANT	.00
c. STATE	.00
d. LOCAL	.00
e. OTHER	.00
f. TOTAL	$ 76568 .00

14. CONGRESSIONAL DISTRICTS OF:
a. APPLICANT
b. PROJECT

16. PROJECT START DATE Year month day 19
17. PROJECT DURATION 12 Months

18. ESTIMATED DATE TO BE SUBMITTED TO FEDERAL AGENCY ▶ Year month day 19

15. TYPE OF CHANGE (For 12e or 12g)
A-Increase Dollars; B-Decrease Dollars; C-Increase Duration; D-Decrease Duration; E-Cancellation; F-Other (Specify):
Enter appropriate letter(s):

19. EXISTING FEDERAL IDENTIFICATION NUMBER

20. FEDERAL AGENCY TO RECEIVE REQUEST (Name, City, State, ZIP code)

21. REMARKS ADDED
☐ Yes ☐ No

SECTION II—CERTIFICATION

22. THE APPLICANT CERTIFIES THAT ▶

a. To the best of my knowledge and belief, data in this preapplication/application are true and correct, the document has been duly authorized by the governing body of the applicant and the applicant will comply with the attached assurances if the assistance is approved.

b. If required by OMB Circular A-95 this application was submitted, pursuant to instructions therein, to appropriate clearinghouses and all responses are attached:

	No response	Response attached
(1)	☐	☐
(2)	☐	☐
(3)	☐	☐

23. CERTIFYING REPRESENTATIVE
a. TYPED NAME AND TITLE: Charles F. Flaherty
b. SIGNATURE: Charles F. Flaherty
c. DATE SIGNED Year month day 19

SECTION III—FEDERAL AGENCY ACTION

24. AGENCY NAME

25. APPLICATION RECEIVED Year month day 19

26. ORGANIZATIONAL UNIT

27. ADMINISTRATIVE OFFICE

28. FEDERAL APPLICATION IDENTIFICATION

29. ADDRESS

30. FEDERAL GRANT IDENTIFICATION

31. ACTION TAKEN
- ☐ a. AWARDED
- ☐ b. REJECTED
- ☐ c. RETURNED FOR AMENDMENT
- ☐ d. DEFERRED
- ☐ e. WITHDRAWN

32. FUNDING

a. FEDERAL	$ .00
b. APPLICANT	.00
c. STATE	.00
d. LOCAL	.00
e. OTHER	.00
f. TOTAL	$ .00

33. ACTION DATE ▶ Year month day 19

34. STARTING DATE Year month day 19

35. CONTACT FOR ADDITIONAL INFORMATION (Name and telephone number)
Alec F. Peck
Boston College
(617)969-0100 Ext4180

36. ENDING DATE Year month day 19

37. REMARKS ADDED
☐ Yes ☐ No

38. FEDERAL AGENCY A-95 ACTION

a. In taking above action, any comments received from clearinghouses were considered. If agency response is due under provisions of Part I, OMB Circular A-95, it has been or is being made.

b. FEDERAL AGENCY A-95 OFFICIAL (Name and telephone no.)

424-101

STANDARD FORM 424 PAGE 1 (10-75)
Prescribed by GSA Federal Management Circular 75-2

Signature Page

DEPARTMENT OF TRANSPORTATION
URBAN MASS TRANSPORTATION ADMINISTRATION
UNIVERSITY RESEARCH AND TRAINING GRANT APPLICATION

1. Name of Institution: Boston College

   Address of Institution: Commonwealth Avenue

   City Chestnut Hill State Massachusetts Zip Code 02167

2. Principal Investigator(s) B.L. Bentzen, Lecturer; R.M. Jackson, Assoc. Professor; A.F. Peck, Assistant Professor

   Academic Address: B-14 McGuinn Hall, Boston College

   Telephone: (617) 969-0100 Ext. 4180

   Co-Principal Investigator: See above

   Title:

   Academic Address:

   Telepone: ( )

3. Name and Title of Officer Authorized to Legally Commit the Institution: Charles F. Flaherty

4. Date of Submittal: March 1,1980

5. Are funds for any part of the Project grant application contained herein being requested in another application or proposal to UMTA, DOT, or any other Federal Agency?

   Yes _____ No xxxxx (If yes, provide details)

6. Does the Institution/Investigator(s) now hold any grant or contract for the same or similar work proposed herein?

   Yes _____ No xxxxx (If yes, provide details)

B L Bentzen Richard Jackson Alice F Peck
Signature(s) of Principal Investigator(s) Named in (2) above

Charles F Flaherty Jr.
Signature of Authorized Officer Named in (3) above

ASSURANCE OF COMPLIANCE WITH THE DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE REGULATION UNDER TITLE VI OF THE CIVIL RIGHTS ACT OF 1964

Boston College
(Name of Applicant) (hereinafter called the "Applicant")

HEREBY AGREES THAT it will comply with title VI of the Civil Rights Act of 1964 (P.L. 88-352) and all requirements imposed by or pursuant to the Regulation of the Department of Health, Education, and Welfare (45 CFR Part 80) issued pursuant to that title, to the end that, in accordance with title VI of that Act and the Regulation, no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the Applicant receives Federal financial assistance from the Department; and HEREBY GIVES ASSURANCE THAT it will immediately take any measures necessary to effectuate this agreement.

If any real property or structure thereon is provided or improved with the aid of Federal financial assistance extended to the Applicant by the Department, this assurance shall obligate the Applicant, or in the case of any transfer of such property, any transferee, for the period during which the real property or structure is used for a purpose for which the Federal financial assistance is extended or for another purpose involving the provision of similar services or benefits. If any personal property is so provided, this assurance shall obligate the Applicant for the period during which it retains ownership or possession of the property. In all other cases, this assurance shall obligate the Applicant for the period during which the Federal financial assistance is extended to it by the Department.

THIS ASSURANCE is given in consideration of and for the purpose of obtaining any and all Federal grants, loans, contracts, property, discounts or other Federal financial assistance extended after the date hereof to the Applicant by the Department, including installment payments after such date on account of applications for Federal financial assistance which were approved before such date. The Applicant recognizes and agrees that such Federal financial assistance will be extended in reliance on the representations and agreements made in this assurance, and that the United States shall have the right to seek judicial enforcement of this assurance. This assurance is binding on the Applicant, its successors, transferees, and assignees, and the person or persons whose signatures appear below are authorized to sign this assurance on behalf of the Applicant.

Dated April 25, 1977

Boston College
(Applicant)

By Celine Dorholeau Ph.D.
(President, Chairman of Board, or comparable authorized official)

Director of Affirmative Action

Chestnut Hill, MA 02167
(Applicant's mailing address)

HEW-441
(12-64)

PART III – BUDGET INFORMATION

Page 1

OMB NO. 80-RO-186

SECTION A – BUDGET SUMMARY

Grant Program, Function or Activity (a)	Federal Catalog No. (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1.		$	$	$	$	$
2.						
3.						
4.						
5. TOTALS		$	$	$	$	$

SECTION B – BUDGET CATEGORIES

6. Object Class Categories	Grant Program, Function or Activity (1)	(2)	(3)	(4)	Total (5)
a. Personnel	$ 35037	$	$	$	$ 35037
b. Fringe Benefits	4803				4803
c. Travel	3890				3890
d. Equipment					
e. Supplies	750				750
f. Contractual					
~~g. Construction~~					
h. Other	10750				10750
i. Total Direct Charges	55230				55230
j. Indirect Charges	21338				21338
k. TOTALS	$ 76568	$	$	$	$ 76568
7. Program Income	$	$	$	$	$

Attachment 4
Page 1 of 1

Table of Contents

INTRODUCTION

The project to develop a set of guidelines providing for barrier-free use of rail rapid transit by visually impaired persons is very timely. To date, most modifications in transit facilities for handicapped persons have emphasized enhanced accessibility for the physically handicapped. However, the number of persons who are estimated to have difficulty identifying visual cues relevant to transit is estimated at between 1,398,000 (Abt Associates, 1969) and 1,970,000 (Research and Development Plan for Improving Transit Accessibility for the Elderly and Handicapped, 1978), or approximately 16% of the total handicapped population.

Their problems in using transit remain largely unsolved. The primary problems of visually impaired transit users are difficulty in obtaining information from conventional (visual) sources, and difficulty avoiding obstacles or hazards. It should be noted that more than two-thirds of the visually impaired population have useful vision (Cruickshank, 1980) and would be aided by improved visual communication systems. Therefore, devices and designs for improving communication with visually handicapped persons are expected in many cases, to enhance communication with non-handicapped users as well.

Persons within the fields of education and rehabilitation of the visually handicapped have now established guidelines for architectural design to facilitate independent travel by visually handicapped persons (Duncan, Gish, Mulholland, & Townsend,1977; Guidelines: Architectural and Environmental Concerns of the Visually Impaired Person, 1977). These guidelines relate to optimal design for both totally blind and low vision persons. In addition, some standards for print and graphic aids for low vision persons and standards

for tactile aids for totally blind persons have been developed (Bentzen, 1977; Greenberg and Sherman, 1970). Orientation and mobility specialists are now trained in analyzing rail rapid transit systems, as well as other environments, to choose optional routes and travel strategies for their clients. Thus, specialists in education and rehabilitation of the visually handicapped are now in a good position to join forces with experts in transportation design and transportation management to develop guidelines for improved communication with visually handicapped users of rail rapid transit.

This proposal presents a plan of work drawing primary leadership from principal investigators who are thoroughly familiar with, and who have participated in, relevant work related to the visually handicapped. One investigator (R. Jackson), in addition to his professional expertise, including research in haptic perception, low vision, and envirmental coding, is also visually impaired. He has used rail rapid transit in New York, Boston, and other metropolitan areas extensively, and his personal insights will help to assure that proposed guidelines will be of practical assistance to the visually impaired consumer.

Another principal investigator (B. Bentzen) directed the evaluation of the first two rail rapid transit maps for the visually handicapped to be produced in the United States (See appendix for reprint of B. Bentzen: Orientation naps for visually impaired persons, Journal of Visual Impairment and Blindness 71: 193-196, 1977). In addition, she has pioneered in the development of both high and intermediate technology production of orientation and mobility maps for the blind (Bentzen, 1972). B. Bentzen's teaching responsibilities at Boston College relate directly to preparing teachers of orientation and mobility for totally blind and low vision persons, including analysis and use of non-visual clues and landmarks for travel.

The third principal investigator, (A. Peck), has had considerable experience in a variety of areas related to this project. In conjunction with Bentzen, he has conducted research on tactile graphics for the blind. As Coordinator of the Severe Special Needs training program and through related experience, he has developed an understanding of multihandicapping conditions and the reciprocal effects of visual impairments and other types of handicaps. He has also conducted research on auditory problems, and on attitudes of various individuals toward the blind.

Consultants in transportation design, architecture and management will assist in development, analysis, and evaluation of alternative communication methods, including tactile and audio cueing.

A primary consultant will be Vukan R. Vuchic who has extensive experience in transit and station design. He is already familiar with extensive and diversified information systems which exist or have been proposed for non-handicapped transit users in the United States, Europe and Japan. His expertise will be especially valuable in identifying existing communication elements which can be adapted in some way to enhance their usefullness by visually impaired transit users.

A second consultant will be John Parrillo, architect, who has been responsible for the rehabilitation of six rapid transit stations in Boston, has worked on the design of handicapped and elderly housing, and on the design of barrier-free public buildings. He has received awards from the Massachusetts Association of Paraplegics and the Boston Housing Authority for barrier-free designs. J. Parrillo has consulted with, and provided service to, Sterling Associates, a Boston-based advocacy-for-the-handicapped group. This group received the praise and recommendation of Mr. Thomas C. O'Brien, Manager of the Office for Special Needs, Massachusetts Bay Transit Authority.

A third minor consultant will be Alice Kidder, who has extensive experience in relating transit user needs to transportation management authorities.

Finally, the principal investigators, because of their backgrounds and other professional responsibilities, have extensive contacts with visually impaired users of rail rapid transit and with teachers of orientation and mobility throughout North America. These contacts will be drawn upon at all appropriate times.

DISCUSSION OF PROJECT TASKS

Task 1. Plan of Work

In the Plan of Work, the principal investigators will refine any or all of the activities contained in this proposal to the satisfaction of UMTA, and will present appropriate task schedules, a program milestone chart which is tied to specific calendar months, and the details of as much of the project as can be specified by the time of the meeting 3 weeks following the award of a Cooperative Agreement. Potential problems will also be discussed in this Plan, which will be based on the methods discussed in this proposal.

Time Commitments of Professional Personnel to Task 1

B. Bentzen 3.5 days

R. Jackson 3.5 days

A. Peck 3.5 days

V. Vuchic 1 day

J. Parillo 1 day

Task 2. Literature Search and Related Research Concerning Persons with Visual Impairment

The principal investigators are, by nature of their training and experience, very familiar with much of the existing literature on the general characteristics of persons with visual impairments. Using this knowledge as a starting point, computer-based and library searches of social science and medical literature will be undertaken to update and further clarify those aspects of visual impairment which are pertinent to the use of rail rapid transit systems.

More importantly, however, the investigators are aware of the fact that traditional diagnostic categories are of little practical value in predicting the nature of mobility problems of the visually impaired. This statement is made because visual impairments are usually classified according to one or more of the following criteria:

Type of Impairment: Problems of visual acuity are essentially impairments in the ability to focus at various distances from objects. Problems with the field of vision are manifest as restrictions in the peripheral field to a certain angle or as spots without vision, known as scotomas.

Degree of Impairment: Legal blindness is a frequently used phrase, which technically means "central visual acuity of 20/200 or less in the letter eye, with corrective lenses, or central visual acuity of more than 20/200 if there is a field defect in which the peripheral field has contracted to such an extent that the widest diameter of visual field subtends an angle of less than 20 degrees."
Partial sight, according to this scheme, is visual acuity between 20/70 and 20/200 in the better eye with correction.
Total blindness, which is relatively rare, refers to the complete absence of vision.

Age of Onset: Because of the additional problems presented by blindness which is present at birth, reference is frequently made to the distinction between congential (present at birth) and adventitious (later age of onset) types of visual impairment.

However, visually impaired individuals also exhibit a wide range of functional problems which are usually not predicted by diagnoses based on the above criteria. For example, some persons who display relatively mild losses of acuity nevertheless become slow, overly cautious, dependent travellers, while some totally blind persons have very few problems travelling independently using a dog guide or long cane.

For this reason, the literature search would be extended beyond those documents which are normally retrievable via computer-based and library searches, and would encompass rarely referenced but important other sources such as (1) anecdotal records made by orientation and mobility instructors, (2) pertinent notes from newsletters such as the Long Cane Newsletter, and (3) research proposals and reports written by professional organizations, students, and others associated with mobility problems.

It is also well known to the investigators that those visually impaired individuals who have more serious travel problems are oftentimes those operating under additional handicapping conditions, such as motor disabilities, mental retardation, and expressive or receptive language problems. By nature of their educational backgrounds and experience, the investigators also have considerable expertise in these areas, and would conduct appropriate literature searches in the social science and medical fields in order to identify information on mobility problems associated with these related conditions.

Finally, the investigators (especially A. Peck) will conduct a field study of a stratified sample of visually impaired transit users. The purpose of this study will be threefold, and will pertain to this task and to tasks 3 and 4:

A) To determine the extent to which the problems that are identified in the literature searches associated with this task and task 3 are viewed as being of significance by the visually impaired population;
B) To determine if there are any significant problems which have been overlooked in the literature searches;
C) To determine the perceptions of this group as to the relative improvement in the ease of travel which they would expect to experience from the devices or designs identified in task 4 which aid communication with non-handicapped transit users.

This study will involve a set of interviews with a stratified sample of visually impaired transit users in the Greater Boston area. The strata will be broken down by degree and type of visual limitation, and will include persons with visual impairments only, and persons with multihandicapping conditions including visual handicaps.

Time Commitments of Professional Personnel to Task 2

B. Bentzen 5 days

R. Jackson 5 days

A. Peck 20 days

Task 3. Literature Search and On-Site Research Pertaining to Rail Rapid Transit

In conjunction with consultants Vukan Vuchic and John Parrillo, the principal investigators (especially A. Peck) will conduct a national and international literature search for articles, documents, and studies pertaining to the problems presented by various rail rapid transit system facilities. The reason for this international scope is that the investigators are aware of certain innovations being implemented in Japanese and European rail systems in order to cope with the problems of visually impaired persons, and it is believed that identifying the specific reasons for these innovations could be of great value. For example, textured surfaces in the pavement are now being used in many Japanese rail facilities in order to alert visually impaired persons to the existence of track hazards, and as travel path indicators. If the studies which were conducted in Japan prior to standardization of the textural cues were located, some of this information could be of great value to this project. Most of the search, of course, would be literature pertinent to facilities in the United States.

On-site verification and study of some of the more commonly identified hazards presented by facilities located above ground, below ground, and at ground level would also be conducted. These on-site inspections would be carried out in Boston, Massachusetts, for the most part, since Boston presents an extensive, complicated rail transit system which is easily accessed by the principal investigators. (Mr. Thomas C. O'Brien, Manager of the Office for Special Needs, Massachusetts Bay Transit Authority, has enthusiastically endorsed this project and indicated that his office will assist the investigators in any way possible with this task.) On-site studies would also be conducted, when necessary, by V. Vuchic in Philadelphia, Pa.

V. Vuchic will also draw extensively on prior knowledge of transit design in the United States, Europe, and Japan.

It is believed that essentially all of the major hazards can be identified using the experience of the principal investigators and consultants Vuchic and Kidder, the national and international literature search, and the on-site inspections.

Equally important in completion of this task will be the identification of the specific functional problems posed by the obstacles. Orientation and Mobility Specialists have identified the role of various sensations in the process of orientation, and have also developed a continuum of mobility skills (Suterko, in Lowenfeld, 1973). The effect of various obstacles and terrains on these specific sensations and on these commonly taught mobility skills is of greatest importance in deciding on appropriate environmental modifications.

A brief overview of the specific sensations to which reference is being made from the perspective of orientation is provided below:

General Audition: Hearing is the prime sensation across long distances for many visually impaired persons. It is used as a receptive source of specific verbal directions and information, as well as a source of information in some of the sensation/ perception activities listed below.

Echolocation : Generally, this term refers to emitting a sound and perceiving the characteristics of the echo reflected from the surrounding environment.

Selective Listening: This refers to the ability to select one sound from the background noise, a requirement for attending to verbal directions (or announcements) against a background of high ambient noise levels.

Sound Localization: This is the ability to locate the exact source of a sound, used, for example, in locating a train door by listening for the sound it makes when opening.

Sound Tracking: This refers to the ability to continuously localize a moving sound source, used, for example, in following other pedestrians to a station exit.

Use of the Sound Shadow: This is the ability to recognize the existence of an object from the filtering effect it has on sound waves reflected into it.

Tactual Sensations: Tactile information is second in importance only to hearing from the perspective of orientation and mobility problems. The sensations normally used are:

Texture: the roughness, smoothness, or specific design of a surface.

Temperature: heat (e.g. from the sun) and cold (e.g. windows in winter).

Air Movement Across the Skin: detection of fans, open doors or windows, etc.

Kinesthesis: The major use of this sensation is in the detection of lateral tilts, inclines, and declines on surfaces which are walked upon. Strongly related to this is:

Muscle Memory: the "automating" of motor movements (including number and size of steps) by repetition in a fixed sequence.

Vestibular Sensations: These are used as feedback on whether or not, and how far, an individual has turned, as well as for the general rotary and linear components of motor movements.

Residual Vision: As much as possible, the visually impaired individual uses what vision is available, even if it is simply light perception.

The mobility skills which were referred to are:

Use of a Sighted Guide: Formal procedures have been developed for the use of a sighted person as a guide and/or teacher of basic mobility skills. These procedures involve various hand positions and specific body movements which have been found to be effective in fundamental mobility for the visually impaired.

Use of the Long Cane: The use of a long cane facilitates safe travel and orientation for many visually impaired individuals. The actual technique used is a somewhat sophisticated one which takes into account the contacting/ negotiation of environmental features in a systematic fashion.

Use of a Dog Guide: Dog guides also facilitate independent travel for many visually impaired individuals, but they pose different considerations from a mobility standpoint.

Electronic Travel Aids (Obstacle Detectors and Environmental Sensors): Several electronic devices have been developed as mobility aids, and some of them have been formally tested by members of the Boston College Peripatology Program. These devices are used by a limited number of visually impaired individuals, but it is important to consider their characteristics when drawing up guidelines. Examples of these are:

Laser Cane: Resembling a Long Cane, the Laser Cane emits three separate laser beams for detection of objects, and then informs the user of the location of objects and drops by emitting a combination of high and low pitched tones and tactile sensations.

Sonic Guide: This is an environmental sensor which uses high frequency tone pips as detectors of objects, and then informs the user of their location (and some other characteristics) via a combination of sounds.

Low Vision Aids: Distance optical aids, such as telescopes and monoculars, are useful to some persons for location and identification of information such as signs.
Magnifiers for near vision enable some low-vision persons to read maps and schedules. Most low vision aids, however, while facilitating use of some visual information, make other information more difficult to perceive.

The principal investigators have considerable expertise in the orientation and mobility areas listed above, and would apply this to the problems in rail rapid transit facilities which are identified during this phase of the project. The result of this effort will be a realistic perspective on the severity of the problems which are identified.

The needs of visually impaired transit users for information such as rail rapid transit routes and schedules, location of stations, location of facilities within stations, identification of correct vehicles and desired stops will also be considered as part of this task. While it is true that

much of this information could be obtained by handicapped travellers by simply asking a sighted individual for assistance, the investigators are sensitive to the problems associated with this method, both from a psychological and a practical standpoint. Underscoring this point is the fact that, according to a survey by Abt Associates (1969), one-fourth of handicapped transit users avoid asking strangers for help. They did find less reluctance on the part of the handicapped to ask transit personnel for assistance, but it must be noted that visually handicapped travellers often have great difficulty locating transit personnel. The development of guidelines sensitive to this problem area will be of great practical value to visually impaired travellers.

Time Commitments of Professional Personnel to Task 3

B. Bentzen	10 days
R. Jackson	5 days
A. Peck	15 days
V. Vuchic	4 days
J. Parrillo	6 days

Task 4. Development of Requirements that Methods of Communication with the Visually Handicapped Must Meet.

Primary responsibility for this task will lie with B. Bentzen and R. Jackson. Relevant literature located in task 2 will be utilized to determine appropriate standards for communication systems for the visually impaired. These will be related specifically to the information needs of blind and low vision users of rail rapid transit. Communication via print, braille, tactile graphic displays, textual coding and audio and electronic cueing will be considered.

Where no guidelines exist, because of gaps in basic research, existing knowledge will be assessed to arrive at an intelligent guideline. New basic research in perception will not be undertaken as part of this project. There are no guidelines for color choice for low vision persons, for example, but existing knowledge of patterns of color vision deficiency and the incidence of diseases associated with these deficiencies will be used to propose acceptable guidelines for choice of colors on maps and other graphic displays.

Relevant literature located in task 3 will be utilized to compile a listing of existing or previously proposed devices or designs for non-handicapped users which have potential for aiding communication with the visually handicapped in systems above ground, below ground, and at ground level.

Results of Part C of the survey of blind transit users, described in task 2, will be related to guidelines proposed by the Committee on Architectual and Environmental Concerns of the Visually Impaired,(American Association of Workers for the Blind, 1977), to focus attention on communication problems experienced by a significant proportion of visually impaired transit users which are not ameliorated by already proposed devices and designs.

Finally, the results of the above efforts in task 4 and the directions they indicate for development of new devices and systems, will be reviewed with consultant A. Kidder. She will assist the principal investigators in identifying approaches to development of new devices and systems which will be acceptable to transportation management authorities. This review will help to insure that the guidelines developed by this project will be ones which can practically be realized in rail rapid transit.

Time Commitments of Professional Personnel to Task 4

B. Bentzen	10 days
R. Jackson	15 days
A. Peck	3 days
A. Kidder	1 day

Task 5. Bibliography on the Blind from the Perspective of Using Transit

Based on the documents, articles, etc. identified in tasks 2 and 3, an extensive annotated bibliography will be developed. Included with this bibliography will be a glossary of operational definitions related to visual impairment, in order to allow members of the transit community to more easily appreciate the information in this bibliography.

Time Commitment of Professional Personnel to Task 5

B. Bentzen	2 days
R. Jackson	2 days
A. Peck	6 days

Task 6. Identification, Analysis, and Evaluation of Alternative Communication Systems

After the major problems associated with use of rail rapid transit systems by visually impaired persons have been identified (tasks 2 and 3) and the requirements for communication with visually impaired travellers have been specified (task 4), the project investigators will focus on solutions to these problems.

Initially, the solutions will be formulated exclusively from the perspective of alternatives for meeting the needs of the blind traveller. V. Vuchio and J. Parrillo will then be consulted in order to identify additional methods, devices or systems.

Afterwards, each proposal alternative will be fully described and analyzed in terms of advantages and disadvantages from several perspectives: (1) operating transportation authorities, (2) equipment manufacturers, (3) non-handicapped users, (4) visually handicapped users, and (5) users having other or additional handicaps.

The concepts for prototype cueing devices will be described, and sketches prepared. Estimated costs of development and evaluation of proposed alternatives will be provided. Estimated costs will be given for implementation of devices in new systems and for retrofitting in existing systems.

A second survey will be undertaken in which visually handicapped rail rapid transit users will be asked to rank order the relative improvement in ease of travel which they would expect to experience from the newly proposed alternatives. Results of this survey will lead to estimates of the cost effectiveness of each alternative in relation to the proportion of visually handicapped persons which it would assist and the extent to which it would be

of assistance.

A survey of a small number of non-handicapped users will also be conducted to ascertain whether proposed alternatives would create difficulties for them or might actually make their use of rail rapid transit easier or safer.

Time Commitments of Professional Personnel to Task 6

B. Bentzen	15 days
R. Jackson	10 days
A. Peck	5 days
V. Vuchic	6 days
J. Parrillo	5 days

Task 7. Outline of Final Report

After prototype cueing devices or systems have been developed to ameliorate specific problems of the visually impaired, an outline of the final report will be prepared by the principal investigators for UMTA review.

A. Kidder will consult regarding format and contents which will make the report and guidelines maximally useful to urban transit authorities. J. Parrillo will consult with regard to architectural drawings and specifications.

Time Commitment of Professional Personnel to Task 7

B. Bentzen	10 days
R. Jackson	10 days
A. Peck	5 days
A. Kidder	1 day
J. Parrillo	2 days

Task 8. Development of Guidelines

The principal investigators will prepare a set of proposed guidelines providing for barrier-free use of rail rapid transit by the blind. This will include recommended methods for testing the effectiveness of the guidelines and the estimated time and resources required for such testing.

V. Vuchic and J. Parrillo will consult on these guidelines from the perspective of rail rapid transit systems.

Time Commitment of Professional Personnel to Task 8

B. Bentzen	7 days
R. Jackson	12 days
A. Peck	5 days
V. Vuchic	3 days
J. Parrillo	2 days

BIBLIOGRAPHY

Abt Associates: Transportation needs of the handicapped. Cambridge, MA., Abt Assoc. 1969. Department of Transportation, Office of Economics, Contract No. T8-304.

Duncan, J., Gish, C., Mulholland, M.E. and Townsend, A.: Environmental modifications for the visually impaired: A handbook. New York: American Foundation for the Blind, 1977.

Guidelines: Architectural and environmental concerns of the visually impaired person, Committee on Architectural and Environmental Concerns of the Visually Impaired, American Association of Workers for the Blind, 1977.

Hulscher, F. R.: Traffic signal facilities for blind pedestrians. Insight, 6:5-22, 1977.

Greenberg, G. L. and Sherman, J. C.: Design of maps for partially seeing children. International Yearbook of Cartography, 10:111-115, 1970.

Bentzen, B. L.: Orientation aids for visually impaired persons, in Environmental modifications for the visually impaired. Journal of Visual Impairment and Blindness 71:453-454, 1977.

Cruickshank, W. M.: Psychology of exceptional children and youth. Englewood Cliffs, N.J.: Prentice-Hall Inc., 4th ed, 1980.

Lowenfeld, B., ed.: The visually handicapped child in school. New York: The John Day Company, 1973.

Research and development plan for improving transit accessibility for the elderly and handicapped. Vol. 1. Background, issues, and recommended approach. Office of Technology Development and Deployment, Urban Mass Transportation Administration, U.S. Department of Transportation, 1978.

SCHEDULE OF MILESTONES, INCLUDING DELIVERABLES (MARKED ***)

	Milestone	Schedule per Months after Project Begins	Task #
1.	Start date is fixed following notice of award.	0	
2.	Work Plan review with UMTA	1	1
3.***	A Glossary of Operational Definitions Related to Visual Impairment - useable as a guide in writing information and guidelines for lay readers	2	5
4.***	Requirements for print, braille, tactile graphic displays, textural coding, and audio and electronic cueing for visually handicapped persons	3	4
5.***	Annotated Bibliography on the Blind from the Perspective of Using Transit	3	5
6.***	Annotated List of extensive and diverse information systems used or proposed for rail rapid transit in the U.S., Europe, and other places	3	3
7.***	Annotated list of existing or previously proposed devices or designs for non-handicapped users which have potential for aiding communication with the visually handicapped	4	3
8.***	Results of Survey I A. Table showing relative improvement which visually handicapped persons would expect from existing or proposed modifications for non-handicapped users. B. Table showing relative importance to visually handicapped users of problems or barriers they encounter in use of rail rapid transit. C. List of alternative solutions suggested by blind persons	4	2
9.***	Priority listing of transit communication problems of the visually handicapped for which no proposed solution exists.	4	2

Schedule of Milestones (continued)

	Milestone	Schedule per Months after Project Begins	Task #
10.	Review of results and plan, to date, with consultant versed in communication of user needs to transportation management authorities.	5	4
11.***	Descriptions and sketches of prototype cueing devices or systems	7	6
12.***	Estimated costs of development and evaluation of prototype cueing devices.	7	6
13.***	Estimated costs for implementation of devices in new systems and for retrofitting in existing systems.	7	6
14.	Interim briefing	7	
15.***	Outline of Final Report	8	7
16.***	Results of Survey II	9	6
	A. Table showing relative improvement which visually impaired persons would expect to result from implementation of prototype devices or systems. B. Table showing relative advantages and disadvantages to non-handicapped transit users, of proposed new cueing devices or systems.		
17.***	Draft of Final Report - This would consist of proposed guidelines including recommended methods for testing the effectiveness of the guidelines and the estimated time and resources required for such testing.	10	8
18.***	Final Report	11	8
19.	Final briefing	12	

PROJECT ADVISORY COMMITTEE

Upon beginning the project, the principal investigators intend to establish a Project Advisory Committee. This committee will be made up of visually impaired transit users, rail rapid transit personnel, and other individuals having great interest in this project. The function of this committee will be to provide feedback on project activities from individuals involved with the major problems on a day to day basis.

Letters of support for this project have already been offered from some prospective members (e.g. Mr. Thomas C. O'Brien, Manager of the Office for Special Needs, MBTA.)

BRIEF PROFILES OF PRIMARY PROJECT PERSONNEL

B. Bentzen

As Coordinator of the Dual Program in Peripatology and Education of the Visually Handicapped at Boston College, Bentzen is continually exposed to the problems addressed by this proposal, and to potential solutions. She has done extensive research on tactile-graphics, and she directed the evaluation of the first two rail rapid transit system maps for the visually handicapped to be developed in the United States (see reprint, Appendix). She has also pioneered in both high and intermediate technology production of tactile maps.

R. Jackson

As Coordinator of the Program for Educators of the Visually Handicapped at Boston College, Jackson is intimately familiar with the major problems of visually handicapped persons in a variety of settings. He is visually impaired himself, and has many personal insights to offer based on his extensive use of rail rapid transit in New York, Boston, and other metropolitan areas. He has conducted relevant research in haptic perception, low vision, and environmental coding.

A. Peck

As Coordinator of the Severe Special Needs training program at Boston College, Peck has a thorough understanding of multihandicapping conditions and of the reciprocal effects of visual impairments and other types of handicaps. In conjunction with Bentzen, he has conducted research on tactile graphics for the blind. He has also conducted research on auditory problems, and on attitudes of various groups toward the blind.

V. Vuchic

As a Professor of Civil and Urban Engineering - Transportation, at the University of Pennsylvania, Vuchic is frequently called upon to consult on the design of rapid transit facilities. Included in his extensive experience are the establishment of design standards for BART stations in San Francisco, design of a station in Hamburg, teaching a graduate course in this area, and publication of several articles on station design.

J. Parrillo

As an architect in the Boston area, Parrillo has worked on rail rapid transit stations and on environmental modifications for the handicapped. He worked on the rehabilitation of six rail rapid transit stations for the MBTA, and received the Massachusetts Association of Paraplegics Award (1977) for his sensitive design of housing for handicapped citizens.

VITA
Billie Louise Bentzen, M.Ed.

Education:

M.Ed.	Boston College	1971	Orientation and Mobility
Teacher Training Program	Perkins School for the Blind, and Boston University (12 hours graduate credit)	1965-1966	
B.S.	Ohio Wesleyan University	1959	Sociology

Professional Experience:

Coordinator-Dual Program preparing students for certification as teachers of the visually handicapped and peripatologists	Boston College	1974-present
Supervisor - Peripatology Students	Boston College	1970-1974
Worked with blind and multihandicapped children and youth	Learning Center for the Visually Handicapped Protestant Guild for the Blind Watertown, Massachusetts	1970-1974
Teacher of the Blind, Social Studies, Sewing and Crafts	Perkins School for the Blind Watertown, Massachusetts	1966-1969
International Travel and Volunteer Work	Asia and Europe	1964-1965
Assistant to the Chief Editor A.M.A. Archives of Ophthalmology	Archives of Ophthalmology	1961-1964
Teacher - 7th Grade Social Studies	Baltimore County, Maryland	1960-1961

Publications:

Bentzen, B.L.: Production and testing of an orientation and travel map for visually impaired persons. New Outlook for the Blind.66: 249-255, 1972.

Bentzen, B.L.: Mobility maps for the blind: Report on a conference at the Univ. of Nottingham. September 14-16, 1972, Long Cane Newsletter. 6: 6-8, 1973.

Bentzen, B.L.: Transfer of learning from school setting to life style in a habilitation program for multihandicapped blind persons. New Outlook for the Blind. 67: 297-300, 1973.

Bentzen, B.L.: Orientation maps for visually impaired persons, Journal of Visual Impairment and Blindness. 71: 193-196, 1977.

Publications (Cont.):

Bentzen, B.L.: Orientation aids for visually impaired persons, in Environmental modifications for the visually impaired. Journal of Visual Impairment and Blindness. 71: 453-454, 1977.

Bentzen, B.L. and Peck, A.: Factors affecting traceability of lines for tactile graphics. Journal of Visual Impairment and Blindness. 73: 264-269, 1979.

Bentzen, B.L.: "Orientation aids", in Principles of Orientation and Mobility. Welch, R. and Blasch, B. Eds., New York: American Foundation for the Blind, 1980.

Easton, R. and Bentzen, B.L.: Perception of tactile route configurations by blind and sighted observers. Accepted for publication. Journal of Visual Impairment and Blindness.

Certifications and Professional Affiliations:

Member: American Association of Workers for the Blind
Member: Review Panel, Journal of Visual Impairment and Blindness
Associate Editor: Long Cane Newsletter

VITA

Richard M. Jackson, Ed.D.

Education

Ed.D.	Columbia University - Teacher's College	1978	Special Education
M.Ed.	Harvard University	1970	Psychology & Education
B.A.	American International College	1968	Psychology

Relevant Experiences

1979-Present Coordinator--Program for Educators of the Visually Handicapped, Boston College

1977-79 Adjunct Assistant Professor of Special Education
Lehman College
Bronx, New York

1975-79 Assistant Professor of Special Education--Coordinator of the Program to Prepare Teachers of the Visually Handicapped
Dominican College
Orangeburg, New York

1974 Member of national committee on the development of competency-based curriculum for teachers of the visually handicapped - American Foundation for the Blind

1973 Advisor and participant in film, NOT WITHOUT SIGHT - American Foundation for the Blind

1973 Consultant in Curriculum revision - New York Institute for the Education of the Blind
Bronx, New York

1973-75 Instructor in Special Education and Practicum Supervisor - Visually Impaired and Multihandicapped Programs - Columbia University

1972 Consultant in perceptual-motor learning, New York Association for the Blind (Orientation and Mobility Department) - New York City

1971 Advisor to National Association of the Visually Handicapped

Publications and Presentations

Jackson, R. M. The role of haptic perception in the cognitive development of severely sensory-impaired children. Report of Special Study Institute on the Multihandicapped. New York: Teachers College, Columbia University, 1

Jackson, R. M. Report of conference on low vision. CEC/DVH Newsletter, Spring, 1974.

Jackson, R. M. Environmental Coding - an approach for facilitating cognitive development in deaf-blind children. Proceedings: The Institute for Deaf-Blind Studies, Sacramento, CA.: California State Department of Education, 1976.

Jackson, R. M., Brauzer, B. and Merrill, E. Visual Preferences Record-Experimental Edition. Blauvelt, New York: Dominican College, Center for Low Vision Studies, 1977.

Jackson, R. M. Perceptual development in pre-school visually handicapped children. Paper presented at North American Conference on Visually Handicapped Infants and Pre-schoolers, Minneapolis, Minn., May, 1978 (proceedings in press).

Jackson, R. M. The use of haptic perceptual activity in the education of deaf-blind children. In J. Sheldon (ed.) Proceedings of Workshop on Perceptual Development. New York: Mid-Atlantic Regional Center for Deaf-Blind Children, 1979.

VITA

Alec F. Peck, Ph.D.

Education

Ph.D.	Pennsylvania State University	1976	Major:Education of Exceptional Children Minor:Audition
Intern	University of Michigan	1975-76	Mentor: William M. Cruickshank
M.S.	Pennsylvania State University	1972	Major:Education of Exceptional Children Area of Emphasis: Emotionally Disturbed
B.A.	University of San Francisco	1968	Major:Psychology Minor:Philosophy

Relevant Experience

1979-Present Coordinator, Doctoral Programs in Special Education and Rehabilitation, Graduate School of Arts and Science, Boston College.
Responsibilities: Re-structuring of components of doctoral program; preparation of newsletter, brochures, related print materials; chairman of admissions committee; ongoing evaluation of program; various related administrative duties.

1978-Present Coordinator, Severe Special Needs Program, Division of Special Education and Rehabilitation, Boston College.
Responsibilities: Initial design of program; annual writing of B.E.H. training grant; recruitment, selection and advisement of students; location, evaluation and supervision of student teaching placements; preparation of annual report to State Department of Education for certification; preparation of tri-monthly newsletter, brochures, catalogue copy, and other print materials; formative and summative (annual) evaluations of all program components; various related administrative duties.

1976-Present Assistant Professor, Division of Special Education and Rehabilitation, Boston College.
Responsibilities: Teaching, research, advisement of graduate and undergraduate students, and membership on various committees.

1975-76 Intern, Institute for the Study of Mental Retardation and Related Disabilities, University of Michigan, and Lecturer, Department of Special Education, University of Michigan.
Responsibilities: Under the guidance of William Cruickshank, attendance at various administrative and clinical functions at the institute, and research activities related to Project KEEPS, a demonstration project for severely handicapped youth. In the Department of Special Education,

teaching of 2 courses: "Methods in Special Education" (undergraduate) and "Education of Emotionally Impaired" (graduate).

1973-75 Part-time programming of CAI and Computer Managed Instruction programs, BOCES III, Dix Hills, New York.
Responsibilities: Writing of drill and practice mathematics programs and programs to schedule learning disabled students into appropriate coursework.

1973-75 Teacher of Learning Disabled (emotionally disturbed and brain-injured) students, James E. Allen Learning Center, Dix Hills, New York.
Responsibilities: Teaching reading and arithmetic to learning disabled secondary students.

1972-75 Independent research with Professor James Prout, Environmental Acoustics Laboratory, Pennsylvania State University.
Responsibilities: Proposal, design, and running of an experiment to assess the effects of transdermal electrostimulation on the auditory evoked response in humans.

1972-73 Staff Member, Computer Assisted Instruction Laboratory (CAI), Penn State University.
Responsibilities: Re-writing and programming of the CAI course CARE I (Introduction to Exceptional Children), personal interaction with students having questions regarding on-line courses, and associated research on other uses of CAI and Computer Managed Instruction related to handicapped children.

1969-71 Technician, Experimental Psychology Division, U.S. Army Medical Research Laboratory, Fort Knox, Kentucky.
Responsibilities: Design and running of an experiment on the use of evoked response audiometry to measure auditory thresholds of chinchilla, including surgical preparation of animals, design and assembly to test apparatus, and analysis of results. Also, assistance on projects designed to measure the effect of impulse noise exposure on humans.

1968-69 Parent Trainer - parents of mentally retarded students, Penn State University.
Responsibilities: Counseling of parents of EMR and TMR students on teaching methods which they could use with their children.

1967-68 Staff Member, McAuley Neuropsychiatric Institute, San Francisco, California.
Responsibilities: Routine ward supervision of adult, adolescent, and child patients, including individual counseling, small group and play therapy under the direction of various consulting and resident psychiatrists

Presentations and Publications

Bentzen, B. L. and Peck, A. Factors affecting traceability of lines for tactile graphics. Journal of Visual Impairment and Blindness, Vol. 73 (7), September, 1979.

Peck, A. F. The use of evoked response audiometry for the rapid assessment of threshold in unanesthetized chinchilla. Paper presented at Annual Meeting, Kentucky and Indiana Psychological Association, Louisville, May, 1971.

Peck, A. F. and Luz, G. Measuring evoked auditory potential thresholds in chinchilla after exposure to impulse noise. U.S. Army Medical Research Laboratory Technical Reports, AD 765-464/3, February, 1973.

Peck, A. F. and Capozzi, M. The use of computer assisted instruction with learning disabled students. Paper presented at Conference on Alternative Instructional Strategies, Suffolk County, New York, April, 1974.

Peck, A. F. and Hartman, K. Training issues for teachers of behaviorally disordered children and youth. Paper presented at New England Regional Conference, Council for Children with Behavior Disorders, Boston, April, 1979.

Peck, A. F. A look at physical disabilities. Paper presented at Annual Conference, Massachusetts Association for Retarded Citizens, Boston, May, 1979.

Peck, A. F. (Chairperson) The use of field demonstrations of competence to certify teachers of severely handicapped children. Paper presented at 26th Annual Conference, American Association on Mental Deficiency, Northeast Region, Waterville Valley, New Hampshire, October, 1979.

Peck, A. F. (group representative) In-service training: why is not the question. Presentation at Annual Conference, American Association for the Education of the Severely and Profoundly Handicapped, Chicago, October, 1979.

Peck, A. F. and Uslan, M. Beliefs of rehabilitation professionals regarding the sighted public's attitudes toward the blind. Journal of Rahabilitation, 1980 (Accepted for publication)

Prout, J. and Peck, A. F. Effects of electrostimulation of hearing on evoked responses in persons having sensorineural hearing loss. Paper presented at Annual Conference, American Audiology Society, Las Vegas, November, 1974.

Turton, L., Peck, A. F. and England, J. Eight reports (approximately 60 pages each) analyzing the programs for severely handicapped children and the inservice needs of the staff in these programs in Northern Michigan Intermediate School Districts. Project KEEPS, ISMRRD, University of Michigan, 1975.

Turton, L. and Peck, A. F. Needs assessment for teachers of severely handicapped students. Paper presented at Annual Convention, Council for Exceptional Children, Chicago, April, 1976.

Turton, L., Peck, A. F. and McDonald, G. Needs assessment of instructional personnel serving the severely handicapped. In Turton, L. (ed.) Selected Papers on Services to the Severely Handicapped. Ann Arbor: University of Michigan, ISMRRD, 1976.

VITA

Vukan R. Vuchic, Ph.D.

Education

Ph.D.	University of California, Berkeley	Transportation Engineering
M. Eng.	University of California, Berkeley	Transportation Engineering
Diploma	University of Belgrade	Transportation Engineering

Academic Appointments

University of California School of Business Administration
Acting Assistant Professor 1966

University of Pennsylvania
Assistant Professor 1967
Associate Professor 1970
Professor of Civil and Urban Engineering - Transportation 1975-Present

Professional Experience

Humburger Hochbahn AG, Hamburg 1960-61
Planning Engineer

Wilbur Smith & Associates, Consulting Engineers
Consulting Engineers
New Haven, Connecticut 1961-63
Principle Engineer 1964-65 (Part time)

University of California
Operations Research Center
Junior Specialist 1966

Consulting Activities

Consultant to several engineering, architectural, and law firms, and to the U.S. Government, including UMTA and Transportation Systems Center

Professional Societies

Institute of Transportation Engineers

American Society of Civil Engineers

Transportation Research Board

International Union of Public Transport (Brussels)

Publications

Over 50 articles in U.S. and foreign journals

Several major reports to government and business

Presentations and Lectures

Presentations and lectures have been delivered to several academic and professional organizations, including more than 25 universities in the U.S., Europe, and the Far East.

PERSONAL RESUME

John G. Parrillo

John G. Parrillo has been a registered Architect since 1967 and has had extensive overall experience ranging from the design and construction of individual buildings and structures to the planning, management and coordination of large-scale development projects, in particular federal and state-supported multifamily housing.

Before starting private practice in 1975, Mr. Parrillo was associated with Campbell, Aldrich and Nulty, Architects, Boston, Massachusetts for five and a half years, as a designer, project manager and since 1972 as a Senior Associate. He continued in that capacity when the firm was changed to Nelson W. Aldrich and Associates.

Projects under his direction there included a large urban renewal mixed use development, a 1000 car turnkey parking facility, several low and moderate income residential developments, a large mixed use complex combining elderly housing, townhouse condominiums and a hotel, and a resort condominium project in northern Michigan. He also directed similar efforts for an office and commercial development, a cancer research laboratory and a modernization project for six rapid transit stations.

Before joining Campbell, Aldrich and Nulty, Mr. Parrillo worked with The Architects Collaborative, Cambridge, Massachusetts and Chloethiel Woodard Smith and Associates, Architects, Washington, D.C. where his experience was primarily in multifamily residential projects with several commercial and institutional buildings.

Mr. Parrillo is a graduate of the Rhode Island School of Design, where he received a B.S. in Architecture in 1963. While there he spent a year of study in Italy as a member of the Rhode Island School of Design European Honors Program. In 1965 he received a M.S. in Architecture from Columbia University where he held a graduate teaching fellowship for two years.

In addition to academic honors, Mr. Parrillo has received numerous awards for his design efforts including a Boston Society of Architects Design Excellence Award and the Massachusetts Association of Paraplegics Award for Excellence in Handicapped Design.

Mr. Parrillo is registered in Massachusetts and Rhode Island, is certified by the National Council of Architectural Registration Boards and has been a member of the American Institute of Architects, the Massachusetts State Association of Architects and the Boston Society of Architects.

He has been an instructor at the Boston Architectural Center and has been active in local civic activities as a member of the Arlington Historical Commission, the Arlington Heritage Trust, and the Town of Arlington Building Practices Committee.

AWARDS TO JOHN G. PARRILLO INC. ARCHITECT

1978 WINNER - TURNKEY ELDERLY HOUSING COMPETITION

Wakefield Housing Authority

1977 DESIGN EXCELLENCE IN HOUSING AWARD

Boston Society of Architects

For: Roslyn Apartments
Roslindale, Massachusetts

1977 ANNUAL MAP AWARD

Massachusetts Association of Paraplegics

For: "outstanding work to enrich the lives of the handicapped

Roslyn Apartments
Roslindale, Massachusetts

1975 CERTIFICATE OF MERIT

Department of Community Affairs, Commonwealth of Massachusett

For: Dracut Elderly Housing Competition
Dracut, Massachusetts

AWARDS TO PROJECTS UNDER THE DIRECTION OF JOHN G. PARRILLO WHILE ASSOCIATED WITH OTHER FIRMS.

1974 WINNER - TURNKEY ELDERLY HOUSING COMPETITION

Boston Housing Authority

1974 WINNER - FAMILY HOUSING SUBMISSION

Boston Housing Authority

1973 WINNER - TURNKEY PARKING GARAGE DESIGN COMPETITION

Salem Off Street Parking Commission, Salem, Massachusetts

PROJECTS - JOHN G. PARRILLO INC. ARCHITECT

ROSLYN APARTMENTS — $ 3,250,000.00

119 Units of Turnkey Elderly Housing
Roslindale, Massachusetts - 1977

Boston Housing Authority

FRIENDSHIP HOUSE — $ 7,000,000.00

172 Units of Elderly Housing
Revere, Massachusetts - 1979

Rumney Marsh Housing Corporation
First Congregational Church
Revere, Massachusetts

TURNKEY ELDERLY HOUSING — $ 1,600,000.00

40 Units of Turnkey Elderly Housing
Wakefield, Massachusetts - 1978-79

Wakefield Housing Authority

ADDITION TO DIAL EXCHANGE BUILDING — $ 150,000.00

North Brookfield, Massachusetts - 1978

New England Telephone Company
Boston, Massachusetts

689 COMMUNITY RESIDENCE — $ 160,000.00

Arlington, Massachusetts - 1979

Department of Community Affairs
Arlington Housing Authority

PROJECTS - JOHN G. PARRILLO INC. ARCHITECT

667 MODERNIZATION PROGRAM $ 80,000.00

Arlington, Massachusetts - 1978-79

Department of Community Affairs
Arlington Housing Authority

ALTERATIONS & IMPROVEMENTS - JR. HIGH SCHOOL $ 65,000.00

Arlington, Massachusetts - 1978

Town of Arlington

HANDICAPPED HOUSING IMPROVEMENTS $ 75,000.00

Boston, Massachusetts - 1979

Boston Housing Authority

INTERIOR DESIGN - ROSLYN APARTMENTS $ 20,000.00

Roslindale, Massachusetts - 1979

Boston Housing Authority

SPACE PLANNING & ALTERATIONS $ 25,000.00

Arlington Town Hall - 1976

Town of Arlington

PRIVATE RESIDENCE $ 75,000.00

Plymouth Massachusetts - 1975

PROJECTS UNDER THE DIRECTION OF JOHN G. PARRILLO WHILE ASSOCIATED WITH OTHER FIRMS.

LAKE SHORE RESORT CONDOMINIUMS $ 1,000,000.00

Glen Arbor, Michigan 1975

Great Lakes Associates Inc. Boston, Massachusetts

ORANGE LINE REHABILITATION $ 1,400,000.00

Rehabilitation of Six Rapid Transit Stations

Massachusetts Bay Transportation Authority 1976

PEQUOT HIGHLANDS $ 6,100,000.00

250 Units of Low and Moderate Income Housing
Salem, Massachusetts

Pequot Associates, Boston, Massachusetts 1974

EAST INDIA SQUARE PARKING GARAGE $ 3,150,000.00

1000 Car Parking Facility over Shopping Mall
Salem, Massachusetts

Salem Off Street Parking Commission 1974

HERITAGE PLAZA EAST URBAN RENEWAL DEVELOPMENT $ 22,000,000.00

Master Plan and Development of Mixed Use Project
Salem, Massachusetts

Mondev Corporation, Montreal, Canada 1974

OFFICE BUILDING $ 1,200,000.00

Salem, Massachusetts

Mondev Corporation, Montreal, Canada 1975

CANCER RESEARCH LABORATORY $ 1,100,000.00

Shrewsbury, Massachusetts

Worcester Foundation for Experimental Biology 1974

Orientation Maps for Visually Impaired Persons

BILLIE LOUISE BENTZEN
Ms. Bentzen is coordinator, Dual Program for Teachers of the Visually Handicapped and Teachers of Orientation and Mobility, Division of Special Education and Rehabilitation, Boston College, Chestnut Hill, Massachusetts.

Reprinted with permission, from the JOURNAL OF VISUAL IMPAIRMENT & BLINDNESS, published by the American Foundation for the Blind, 15 West 16th Street, New York, New York 10011.

Abstract: *Copies of two tactile maps—a relatively simple map of the Boston rapid transit system and a detailed map of the Boston-Cambridge area—were given to each of 18 visually impaired travelers. These individuals agreed to plan and travel an unfamiliar route using the maps and to report back on their experiences to peripatologists and map makers. Both maps proved helpful in travel planning and in gaining a better understanding of the spatial relationships of the city and of the relationships of major transportation links.*

Commerical production of orientation maps for visually impaired persons is becoming a reality in the United States. Although much basic research remains to be done, two pioneering teams each have designed and commercially produced a map to facilitate the orientation and independent travel of visually impaired persons in the Boston, Massachusetts area.

The Division of Special Education and Rehabilitation of Boston College conducted a series of dialogues in spring 1975, between visually impaired travelers, peripatologists and the producers of these maps, in order to:

1. Make peripatologists and visually impaired travelers aware of the existence of the maps and of their possible uses
2. Acquaint peripatologists with techniques for using highly complex maps with their students
3. Learn for what purposes such maps would actually be used by visually impaired travelers
4. Provide feedback to map producers and peripatologists, from a variety of visually impaired travelers, indicating criteria for production of future orientation maps.

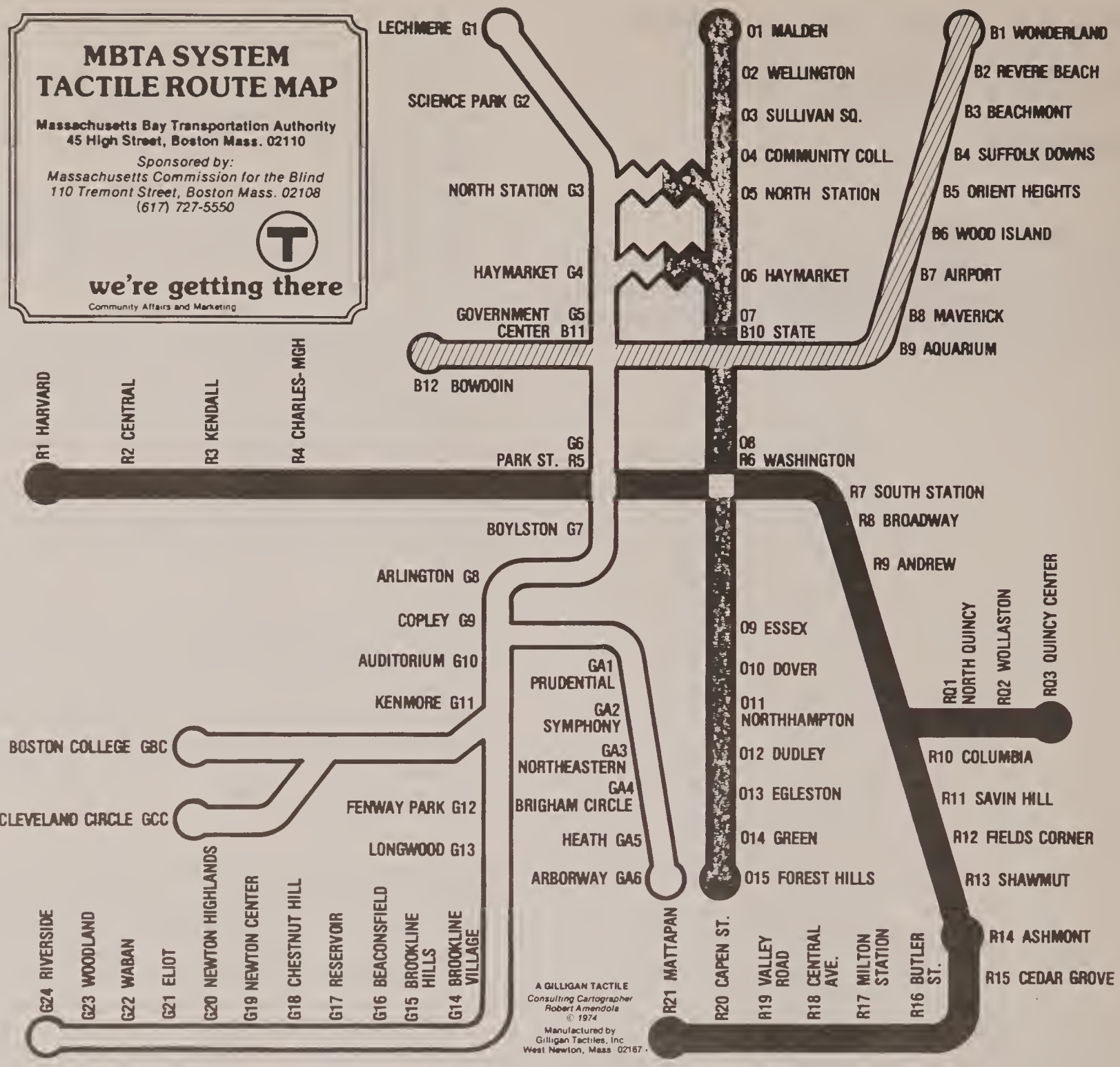
The two maps were designed and produced by entirely independent teams, and the content and reproduction techniques differ greatly. Visually impaired travelers and peripatologists were asked to actually use each of the maps to plan and to travel (or have a student plan and travel) to a destination in an unfamiliar area. This was a prerequisite for participation in the dialogue and ensured feedback based on actual use, not just perusal.

TWO MAPS

The simplest of the two maps, the *MBTA System Tactile Route Map*, portrays the complete rapid transit system of the Metropolitan Boston Transportation Authority. Tactile information is presented on transparent plastic and this is backed with a corresponding four color print map of the system. The same tactile linear symbol is used to represent all four transit routes in the system; this is a furrow, 1/5″ wide and .01″ [5.1mm by .25 mm] deep. Brief "Instructions for Using the MBTA System Map" are provided in braille and large type.

The highly complex *Boston-Cambridge Tactual Map* portrays an approximately ten square mile area, including all of Boston and Cambridge, and adjoining areas of Brookline and Somerville. This map consists of one visual, and three tactile-visual layers, each giving different information about the same area, at the same scale. Information portrayed includes: all streets; residential areas; shopping areas, green spaces; water bodies; landmarks such as public buildings, universities and museums, with the locations of their main entrances; names of major streets; names of parts of the cities; all the rapid transit routes which serve the geographic area included in the map; and the 17 most traveled bus routes in this area. A total of 19 tactually and visually different point, linear, and areal symbols are used to represent the various kinds of information. This map is accompanied by an "Introductory Tape to the Boston-Cambridge Tactual Map," which describes the map and gives techniques for reading it. It is also accompanied by a large directory containing additional information about the rapid transit system, and an alphabetical listing of all streets and landmarks shown, with their grid reference locations.

Detailed specifications of the two maps are given on pp. 194 and 195.



MBTA System Tactile Route Map*

The information content of this map, designed by Robert Amendola and produced by Gilligan Tactiles, Inc., consists of the complete rapid transit system (underground and above-ground) of the Metropolitan Boston Transportation Authority. All regular stops and transfer stations in the system are labeled with the initial letter of the color code for the route (i.e., R for red route) and a number. Stops are numbered consecutively from either the northern or western terminus of each route. Transfer stations are given a letter and number for each route using the station. For example, Park Station is designated G6 and R5 because it serves both the green and the red routes. All letters and numbers are either horizontal or vertical on the page. An index is provided which lists all stops on each line, in their numbered order; the index is available in braille and print.

The map is 11.0″ x 11.5″ [27.9cm by 29.2cm] in overall size. It is embossed in a transparent plastic, which is backed with and adhered to a registered four color print map, containing the same information as the embossed map, but in a form intended for the use of sighted or partially sighted persons. It is believed to be the first orientation map commercially produced in the United States for both totally blind and partially sighted users. The map is flexible, but folding creates permanent creases.

Symbols used on the embossed map are a furrow, 1/5″ wide and .01″ deep [5.1mm x .25mm], representing the routes themselves, and containing dots, 1/16″ [1.6mm] in diameter and .016″ [0.4mm] high, representing the stops. A furrow in a zig-zag pattern connects stops on parallel routes that are connected underground by pedestrian tunnels. The letter and number designations of stops are written in standard braille near the dot for each stop.

The print map utilizes a different color, red, green, blue, or orange, for each route. Length and directionality of the routes are schematized. Names of stops are printed in black 11 point type, under or close to the braille label for each stop.

*The MBTA System Tactile Route Map, in revised form (1976) is available free of charge through the Massachusetts Commission for the Blind, 110 Tremont Street, Boston, Massachusetts.

Boston-Cambridge Tactual Map**

This map was designed by Knut Lieneman (Massachusetts Institute of Technology, Planning Office), and produced by Plastic Lace Corp. and Howe Press of Perkins School for the Blind. It covers a rectangular area of approximately 10 square miles [25km], including all of Boston and Cambridge, and adjoining areas of Brookline and Somerville. The map is 23.5″ x 17.5″ [59.7cm by 44.5cm] in overall size, and the scale is approximately 1″ = 1000′ [1cm = 0.12km]. This map is very flexible and can be folded repeatedly without producing permanent creases. (See photo on cover of this Journal.)

The map consists of one visual and three tactile-visual layers, each giving different information about the same area, at the same scale. These layers are registered, and bound together along the north edge. They will be described separately, from the first, or top layer, to the last, or bottom layer.

Layer 1. This layer, intended for the use of sighted persons who were assisting blind persons in the use of the map, was not specifically designed for the use of partially sighted persons. It is a transparent vinyl overlay, with black printing, showing all streets, industrial areas, shopping areas, green spaces, water bodies, and numerous landmarks such as public buildings, universities and museums. The locations of the main entrances to these buildings are also shown.

Major streets and landmarks are labeled in 8 to 12 point type. A key to the symbols for all layers is given at the bottom of this layer. Grid lines, with letters and numbers, are given along both sides and the bottom of this layer.

Layer 2. This is a tactile-visual layer, produced in polyvinyl chloride. All information that is tactually perceptible is printed, and no additional print information is given. However, it was not the specific intent of the designer and producers of this map that the visual properties would be used by partially sighted persons; visual properties were an incidental factor of the production process. Symbol choice and density were based solely on tactual discriminability and recognizability.

With the exception of print names and explanations in the key, all of the information contained on Layer 1 is reproduced on Layer 2, with the visual symbols of Layer 1 produced at varying elevations (.006″ to .03″) [0.2mm to .8mm]. The key explanations are produced in braille.

Layer 3. This is another tactile-visual layer, produced on polyvinyl chloride. It is adhered to the back of Layer 2, producing an underlay.

This layer contains, in regular braille, the names of major streets, and, in jumbo braille, the names of parts of the cities. The braille is oriented to correspond as nearly as possible to the linear direction of the street being labeled.

The reader places the fingers of one hand, palm upwards, on Layer 3 to locate the name of a street that is tactually available to the other hand on Layer 2.

Layer 4. This is another tactile-visual layer produced on polyvinyl chloride. It contains all of the rapid transit (MBTA) routes that serve the geographic area included in the map, and routes of 17 of the most traveled buses in this area.

Each rapid transit route is represented by a tactually and visually distinct linear symbol, while the bus routes are all represented by one additional tactually and visually distinct linear symbol. All stops of rapid transit routes are represented by a circle, 19/64″ [7.5mm] in diameter, which interrupts the line. Circles that are solidly raised represent underground stops, and circles with raised outlines represent above-ground stops. The name of each stop is written out in braille.

A key at the bottom identifies all symbols.

The map is accompanied by a large directory which, in print and braille, contains an alphabetical listing of all streets and landmarks shown, with their grid reference locations. It also lists all rapid transit stops, indicating: on what level the trains run (elevated, ground level, below ground or on a lower level beneath another train); whether entrances lead to inbound, outbound, or all trains; whether a footbridge leads to the station; and where the platform is located in relation to the direction of the trains.

An "Introductory Tape to the Boston-Cambridge Tactual Map" accompanies each map and directory. The tape cassette describes the map and gives techniques for reading it to enable the visually impaired person to independently familiarize himself with the map.

**The Boston-Cambridge Tactual Map is available on loan from the Research Library, Perkins School for the Blind, 175 N. Beacon St., Watertown, Massachusetts.

The Dialogues

Peripatologists and agencies serving visually impaired persons provided names of visually impaired individuals in greater Boston who were known to be independent travelers. (No attempt was made to obtain a complete list of independent travelers.) Eighteen persons were selected, who were willing to plan and travel a route to a destination in an unfamiliar area, using the maps, and to share their experiences in a dialogue with peripatologists and map makers. For the convenience of participants, two dialogues were scheduled, each including visually impaired travelers, peripatologists and map makers.

The 18 visually impaired travelers received copies of both maps, and were offered instruction in their use. However, none needed assistance to enable them to read and utilize the MBTA System Tactile Route Map. Four participants currently receiving instruction in orientation and mobility were taught by their instructors to use the Boston-Cambridge Tactual Map. The remaining 14 taught themselves to read and utilize the Boston-Cambridge Tactual Map, using the introductory tape and the directory as guides.

Seventeen peripatologists in the greater Boston area were interested and willing to utilize the maps with one or more visually impaired students, to plan and travel routes to destinations in unfamiliar areas based on information provided in the maps, and to share their experiences in a dialogue. (Several who wished to participate did not have students at an appropriate level, during the time period allowed, to fulfill this requirement. They participated in the dialogue, nevertheless.) Ten peripatologists attended a training workshop to learn techniques for utilizing these maps with visually impaired students.

Visually impaired participants were asked to complete questionnaires regarding the routes they planned and traveled using the maps, the difficulties they had with the maps, what they liked best about the maps, and suggestions for improvement in orientation maps. (Data were also gathered concerning such dependent variables as extent of visual impairment, characteristics of near and distant visual functioning, extent of independent travel, and previous experiences using maps. The small size of the sample makes such data statistically irrelevant, but nonetheless informative as part of individual case studies.)

Conclusions of the Dialogues

The MBTA System Tactile Route Map gave information sufficient only for travel from one stop to another, not to above-ground destinations near those stops. Many participants were already very familiar with all lines of the MBTA, and did not travel new routes using this map. Some, nevertheless, found that the graphic portrayal of the relationship of MBTA routes to each other clarified for them the parts of the city served by each route. As a travel aid, most participants found the index of stops to be just as informative as the map itself. This was particularly true since the labeling system for stops required reference to the index to identify particular stops.

The Boston-Cambridge Tactual Map has much greater information content, but covers a smaller geographic area. Although it is theoretically possible to plan almost door-to-door routes to destinations within the area of the map, some omissions and inaccuracies made this difficult to carry out without some need for assistance when the traveler knew he was close to his destination. Specifically, the grid reference system was not exact enough to pinpoint the location of minor streets; the building numbering system of each street was not given in the directory; and some streets were omitted. Most participants did travel one or more door-to-door routes to destinations in an unfamiliar area using this map, supplemented by soliciting aid when they were near their destinations.

The greatest benefits participants derived from the Boston-Cambridge map were not in specific route planning but in:

1. Knowledge of the spatial relationships of parts of the cities to each other
2. Understanding the relationship of major transportation links to the cities they serve
3. Knowledge of land use patterns within the cities.

Two participants found the map extremely helpful in enabling them to search intelligently for housing in the Boston-Cambridge area. They could be independent in deciding whether a possible residence was sufficiently accessible to public transportation and in close enough proximity to parts of the cities they used most frequently.

Several participants found the map most useful for helping sighted friends navigate unfamiliar auto routes in the cities.

Every item of information contained in both maps was usable by all participants. There were numerous suggestions for changes or additions, but no clear agreement on the desirability of any particular changes except for the correction of errors.

Although symbol choice and standards for symbol density for both maps were based on opinions of individual visually impaired consultants and on personal experience of the designers, rather than on results of controlled research on symbol discriminability and recognizability, no symbol was found totally illegible by any participant. Opinions varied concerning which symbols were the most difficult to locate, trace, or recognize.

There was no consensus to support the hypothesis (Amendola, 1976) that the furrow as used in the MBTA System Tactile Route Map was, for these subjects, superior in tracing qualities to the varied linear symbols used in the Boston-Cambridge Tactual Map. A majority of participants favored the representation of different MBTA routes with tactually distinct linear symbols, as done in the Boston-Cambridge Tactual Map, because it facilitated following routes across intersections.

Although information density was far greater on the Boston-Cambridge Tactual Map than on the MBTA System Tactile Route Map, no participant found the information density unmanageable. Most suggestions for changes in the Boston-Cambridge map itself would, in fact, result in increasing the information content and density in some areas.

Of the 18 visually impaired participants, five had usable residual vision for some near tasks. All of these participants used both the tactile and visual features of both maps, although scanning and tracing techniques differed greatly. Layer 1 (print only) of the Boston-Cambridge Tactual Map was used by these five participants, who enhanced its visual contrast by inserting a sheet of white or yellow paper between Layer 1 and Layer 2.

Conclusions

Capable and motivated visually impaired travelers can employ both simple and highly complex maps to assist them in travel planning and also to increase their knowledge and understanding of a city. Not all visually impaired travelers will need instruction in the use of such maps if they are accompanied by effective verbal instructions.

Linear symbols consisting of both single and double lines were effective in communicating directionality and could be tactually traced by all participants.

Participants having some usable near point vision utilized both the tactile and visual coding systems of both maps.

Implications for Future Research and Development

The search should be continued for inexpensive means to commercially produce and reproduce maps of metropolitan areas for visually impaired persons. Where economically feasible, maps of metropolitan areas should include both street patterns and public transportation systems, as one of the greatest benefits derived by the visually impaired persons in this study was the opportunity to discover the relationships of parts of the cities and of specific landmarks in the cities, to transportation services.

Maps should be accompanied by instructions for their use. The instructions should be sufficiently clear and complete to enable visually impaired travelers to use the maps without the need for personal instruction in the use of each map.

Future maps for visually impaired persons should include both tactual and visual coding systems to enhance their usefulness for partially sighted persons. ■

Reference

Amendola, R. Practical considerations in tactile map design. *Long Cane Newsletter*, 1976, 9, 22-24.